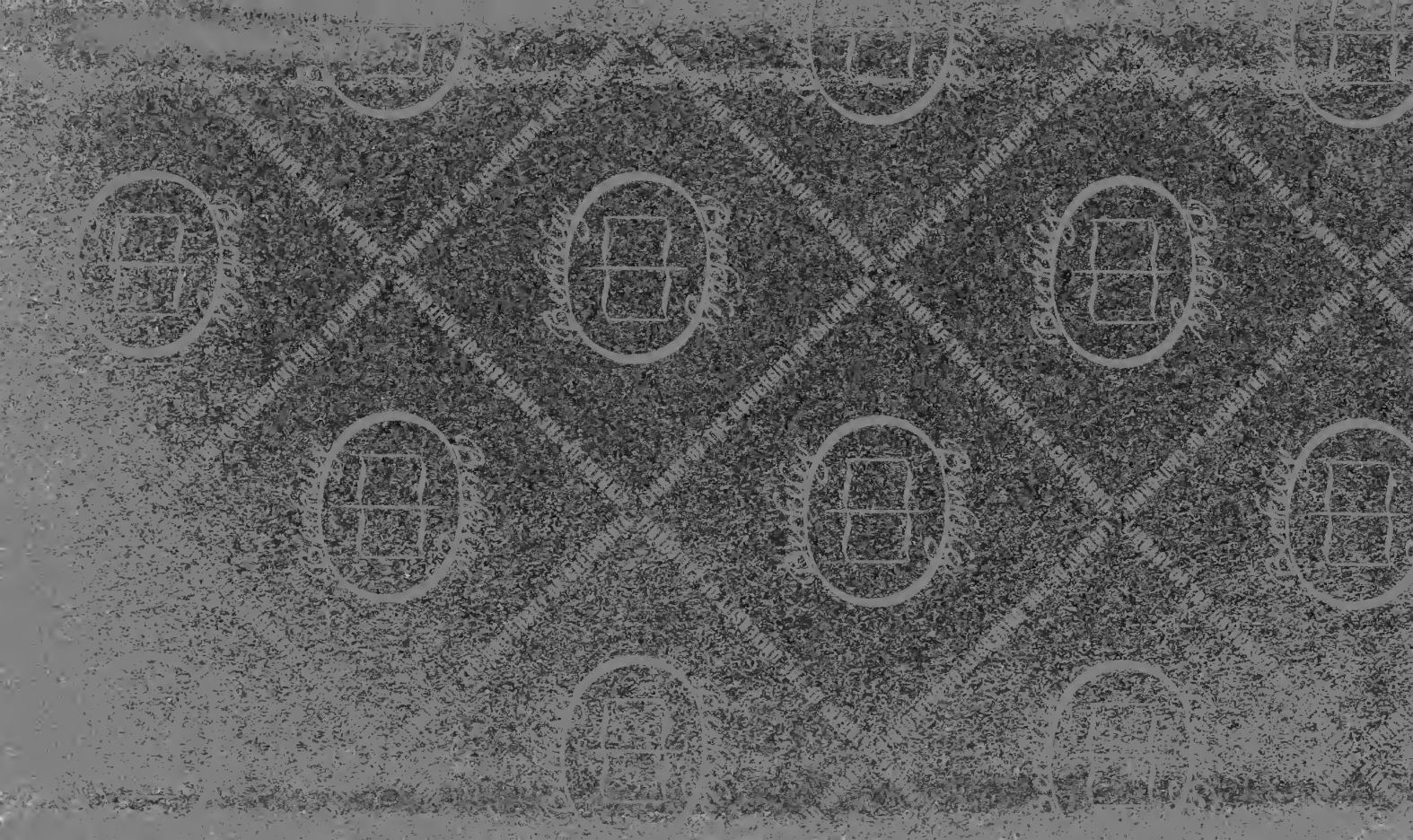

HISTORY OF MINING AND QUARRYING IN MINNESOTA.*

BY THE SECRETARY, WARREN UPHAM.

COPPER.

On Isle Royale, in lake Superior within sight of the Minnesota shore, native copper had been mined before the coming of white men. This was the only metal which the aboriginal people of our region had learned to obtain by mining, but only very scanty supplies were derived from their rude shallow excavations, worked with the aid of water-rounded beach cobbles for hammering and breaking up the inclosing rock.† Probably more of the copper in use among the Indians before the advent of European commerce was derived from masses and fragments of native copper found in the glacial drift.

The earliest mining within the area that now is Minnesota was by Le Sueur, who in April, 1701, mined 30,000 pounds of what he supposed to be an ore of copper, from the bank of the Blue Earth river or of the Le Sueur river near their junction, a few miles southwest of Mankato. He sent 4,000 pounds of this material to France.‡ It was probably a peculiar dark green shale, which outcrops beside the Blue Earth river, or an equally remarkable blue earth of the same vicinity, which the Sioux used as a pigment, in either case worthless as a source of copper or any metallic product.

The Keweenawan rock series, from which copper is very profitably mined in the upper peninsula of Michigan, extends

*An address at the Annual Meeting of the Minnesota Historical Society, Jan. 18, 1897.

†N. H. Winchell, Bulletin of the Minnesota Academy of Natural Sciences, vol. II, pp. 29-34, April, 1881; Popular Science Monthly, vol. XIX, pp. 601-620, Sept., 1881. R . L. Packard, Smithsonian Report, 1892, pp. 175-198 (also in Am. Antiquarian, vol. XV, 1893). In 1892, for the Smithsonian Institution, Prof. W .H. Holmes visited Isle Royale and mapped its shafts and pits of the aboriginal copper mining, finding their number about one thousand.

‡Minnesota Historical Society Collections, vol. I, p. 337; vol. III, pp. 7-12, Geology of Minnesota, vol. I, pp. 16-18, 59, 71, 428, 435.

also through northern Wisconsin and into northeastern Minnesota, occurring on the St. Croix river at Taylor's Falls, northward on this river and its tributaries, and on a large area north of lake Superior. Traces of native copper and of its ores are frequent in these rocks in Minnesota; but no large bodies of the metal or ore have been discovered by much exploration. Mining has been attempted in many places, but hitherto unsuccessfully, beginning in the year 1864. Prof. C. W. Hall has written a brief history of this copper mining in Minnesota, and doubts that it will ever become a profitable industry.*

GOLD.

In very small quantities gold has been washed from gravel and sand of the glacial drift, and of stream alluvium derived from the drift, in Fillmore, Olmsted, and Wabasha counties of southeastern Minnesota, as noted by Prof. N. H. Winchell in his reports as state geologist; but it is not found in remunerative amount. The gold occurs there as a minute ingredient of the drift, belonging probably to its part gathered from the recently discovered gold-bearing district upon and north of our international boundary. Although a similar proportion of the precious metal is undoubtedly present in the drift on all the intervening region, it will quite surely nowhere pay for placer mining.

The Vermilion Lake district, near the northern boundary of Minnesota, was the scene of a very remarkable excitement for gold mining during the years 1866-68. A report by Henry H. Eames, the state geologist, published in 1866, announced that analyses of quartz from veins in that district yielded gold at the rate of $20 to $30 per ton. A road was laid out seventy-five miles through the forest, from Duluth to Vermilion lake. Numerous companies began mining, and built four stamp mills. A town site, named Winston, was surveyed, and several large buildings were erected. But the enterprise was wholly unremunerative, and was soon abandoned, so that ten years later only one white man was living in the district.† It has since,

*Bulletin of the Minnesota Academy of Natural Sciences, vol. III, pp. 105-111, Oct., 1885.

†N. H. Winchell, Minnesota Geological Survey, Seventh Annual Report, for 1878, pages 23, 24.

however, been found to contain very valuable iron ores, which are now being extensively and profitably mined.

On the northern side of the Lake of the Woods, in Canada, gold ores were discovered in 1878, which have been worked profitably at the Sultana and other mines. In Archæan rocks of similar character, within the limits of Minnesota, gold has been discovered and mined, in 1893 and since that date, on the southern shores and islands of Rainy lake, as well as in the country north of this lake, belonging to Canada. The description, history, and prospects of this gold-producing district are the subject of a report by H. V. Winchell and U. S. Grant,* whose conclusions have been presented in previous pages (8 and 9) of this volume.

IRON.

The prominence of Minnesota as a mining state dates from the development, within the past thirteen years, of rich iron ore deposits north of lake Superior. These are found along two belts of great extent from northeast to southwest, known as the Vermilion range and the Mesabi range.

The iron ores of the Vermilion range were first described in published reports by Eames and Whittlesey in 1866. Nine years later the first blasting on this range was done by George R. Stuntz and John Mallmann, near the present town of Tower. Again nine years passed before the Duluth and Iron Range railroad was opened from Two Harbors on lake Superior to Tower, when, in 1884, the earliest exportation of ore took place, the product shipped that year being 62,124 tons. In 1886 the mines at Ely, about twenty miles farther east on this range, were opened, the railroad being extended there.

On the Mesabi range, approximately parallel with the foregoing and fifteen to twenty miles south from it, iron ores were earliest noted by Norwood in 1850, and by Eames in 1866. The discoveries of its great deposits of very cheaply workable ore have all been made, however, within the past seven years, chiefly in 1890 to 1893, and were due in large measure to persistent exploration by the Merritt brothers, of Duluth. The Mountain Iron deposit was found in November, 1890, and the deposits at Biwabik and in its vicinity less than a year later.

*Minnesota Geological Survey, Twenty-third Annual Report, for 1894, pages 36-105, with map and sections.

Within the next three years the production of iron ore from this range, to which two railroads were built in 1892, in addition to the previously developed mining of the Vermilion range, placed Minnesota in the front rank of the iron-producing states of the Union.*

COAL.

Because of the lack of coal in the rock formations of Minnesota, the iron ores so abundantly mined here have been carried by lake steamships to other states, chiefly to Cleveland and other Ohio ports, for manufacturing into iron and steel where coal is cheaply obtained from neighboring coal-mining districts. It will doubtless be found practicable, however, to establish iron furnaces on remunerative conditions in Duluth and Two Harbors, Minn., and in West Superior, Wis., the ports of lading of the Minnesota iron ores, so that an important part of the ore product shall be smelted at home, with coal brought very cheaply as return cargo by the ore-carrying steamers.

Coal of the inferior quality named lignite, in strata of Cretaceous age, probably no more than a third as old as the coal of the eastern United States, is found in a few localities of Minnesota in thin seams, rarely more than a foot thick and therefore impossible to be profitably mined. Such lignite layers have been exploited near Richmond, Stearns county, about the year 1865, and in 1871, and since then; on the Cottonwood river nearly thirty miles west of New Ulm, in 1865; and at several places in the bluffs of the Minnesota valley and its tributary ravines in Redwood county and near Fort Ridgely, in 1871 and later. Within recent years much search for lignite has been made in northern Minnesota, where too its fragments occur in the glacial drift; but nothing of value has

*The history of iron-mining in this state, to the end of the year 1894, is summarized in an earlier paper of this volume (pages 25-40, with map) by the state geologist, Prof. N. H. Winchell. More fully this history, up to the year 1891, is stated by the same author and his son, Horace V. Winchell, in their report, "The Iron Ores of Minnesota" (pages 430, with a geological map, 26 figures, and 44 plates, 1891), being Bulletin No. 6 of the State Geological Survey publications; by J. E. Spurr, in "The Iron-Bearing Rocks of the Mesabi Range" (pages 268, with 22 figures in the text, and 12 plates, 1894), being Bulletin No. 10 of this Survey; and by H. V. Winchell in his papers, "The Mesabi Iron Range," Twentieth Annual Report of this Survey, for 1891 (pp. 111-180, with sections), and "Historical Sketch of the Discovery of Mineral Deposits in the Lake Superior Region," Twenty-third Annual Report, for 1894 (pp. 116-155). The first of these reports includes a very complete bibliography of iron ores and their mining; and the last has a bibliography of the history of mining in the region of lake Superior.

been discovered, nor indeed probably exists in this state. The thin lignite beds here mentioned are nearly of the same quality as the lignite mined on the Missouri and Mouse rivers and westward in North Dakota, suitable for many uses as fuel, but illy adapted for smelting or manufacturing purposes.

GRANITE AND GNEISS.

Minnesota has excellent building stones, which are much quarried. including granite (with gneiss), sandstone (with quartzite), and limestone.* The following are brief notes of the dates of their earliest quarrying, and of buildings in which they have been used.

In the vicinity of Sauk Rapids and St. Cloud, granite quarrying was begun in 1867. Numerous varieties of granite are there quarried, and have been much used as the trimmings of large buildings in Minneapolis and St. Paul, for the masonry of the Northern Pacific railroad bridge over the Missouri river at Bismarck, and in many other structures in Minnesota and adjoining states and in Manitoba.

Gneiss, differing from granite in its foliated texture, has been extensively quarried during the past ten years near Ortonville, being used chiefly for the Minneapolis and Hennepin County public building.

QUARTZITE AND SANDSTONE.

Quartzite, which is a very hard and crystalline sandstone, was quarried slightly in its outcrops on the northeast side of the Minnesota valley, opposite to New Ulm, in 1859. It forms a great ridge in the north part of Cottonwood county, and has plentiful outcrops in Pipestone and Rock counties, there inclosing the thin layer of pipestone (catlinite), and rising prominently in "The Mound," near Luverne. It has been slightly quarried in these counties, but more, during the past twenty years or longer, at the city of Sioux Falls, in South Dakota, where it is considerably used for building and is to some extent exported, under the name of "jasper," for ornamental uses.

* "The Building Stones of Minnesota," by N. H. Winchell, Minn. Geol. Survey, Final Report, vol. I, 1884, pp. 142-203, with eight plates, and a table giving results of tests of the qualities of these stones.

Sandstone quarrying was begun at Hinckley in 1878, and several years later at Sandstone on the Kettle river. These quarries have yielded large supplies for buildings, bridge masonry, and harbor improvements, employing hundreds of men throughout the year.

The red sandstone at Fond du Lac, a favorite stone for building churches and residences, was first quarried in 1870.

At Dresbach, in Winona county, good quarries of a white sandstone were first worked in 1881, being opened in accordance with the advice of the state geologist. A similar stone had been quarried at Jordan, in the Minnesota valley, in 1858, and especially in 1878-79, being used for the erection of the Jordan flouring mills.

Lower in the Minnesota valley, near its mouth, the St. Peter sandstone, in a locality where it is indurated by iron rust, was first quarried in 1869, and in 1878 yielded the stone of the tall piers of the Fort Snelling highway bridge.

LIMESTONE.

The earliest quarrying in Minnesota was in the Trenton limestone, which forms the upper part of the Mississippi river bluffs at St. Paul and thence up the river to Fort Snelling and the Falls of St. Anthony. It was quarried in 1820-21 for building Fort Snelling, and in 1836 for Gen. Sibley's house at Mendota, the first residence built of stone in this state.

The extensive quarrying of this limestone in St. Paul was begun in 1856, nearly on the site of the present capitol building; and on the river bluffs in West St. Paul quarries were opened in 1858. It is the stone of the old post-office and custom house in this city, as also of the Catholic Cathedral, the German Catholic church, the Fire and Marine Insurance Building, and many other business blocks, churches, and residences.

In St. Anthony (now the east part of Minneapolis) this limestone was first quarried in 1856, and in 1857 the earliest part of the old main building of the State University was constructed of it. On the west side of the river there its quarrying began in 1864, and on Nicollet island in 1865. The Church of the Redeemer and most of the flouring mills of Minneapolis are built of this stone.

Southeastward in this state, the Trenton limestone is quarried in many places, as at Dundas, supplying the stone of some of the buildings of Carleton College, Northfield; near Faribault, being used for many buildings there; and near Fountain, in Fillmore county.

The nearly related Galena limestone has been largely quarried at Mantorville, first in 1856, supplying much stone for southern Minnesota before the building of our first railroads.

The Shakopee and St. Lawrence limestones, of lower stratigraphic position than the foregoing, are also much quarried southeastward, in the bluffs of the Mississippi and Minnesota rivers and their tributaries, as at Stillwater, in the St. Croix valley; at Red Wing, Frontenac, Winona, Stockton, and many other places, along and near the Mississippi valley; at Lanesboro, on the Root river; and at Shakopee, Kasota, Mankato, and St. Lawrence, in the Minnesota valley.

The earliest Stillwater quarry was opened by Dr. Christopher Carli in 1847, at the top of the bluff near the northern limits of the city. Other quarries were opened in 1854, and have been extensively worked, from which many public buildings and residences in Stillwater have been erected.

Quarrying was begun at Red Wing in 1865; at Frontenac and Florence, about 1855; at Winona, in 1854; and near Stockton, at the large quarries of the Chicago and Northwestern Railway Company, in 1876. From the Winona quarries are built the State Normal School, and the Congregational and Episcopal churches, in that city.

Kasota, from quarries first worked in 1868, supplies buff-colored limestone, very desirable for fronts of buildings and for trimmings, which is shipped to Minneapolis, St. Paul, Chicago, Winnipeg, and many other cities throughout the Northwest. The First Baptist Church in St. Paul, and the Kasota Block in Minneapolis, are of this stone.

In Mankato, quarrying was begun in 1853. During the past twenty-five years these quarries have supplied most of the stone used for bridge masonry along the Chicago and Northwestern railway and its branches westward through this state and in South Dakota. The same magnesian limestone is also largely burned for lime in this city, and at Ottawa and Shako-

pee; and during the last fifteen years it has been extensively used at Mankato in the manufacture of hydraulic cement.

Much lime is produced from this formation likewise in the Mississippi valley, especially at Red Wing and Winona.

CLAY.

The great demand for bricks as a building material has caused brickmaking to become an important industry in or near several of our cities and towns, as Red Wing, Minneapolis, Chaska, Mankato, Brainerd, Moorhead, and Crookston. The clay used is a part of the modified drift which was deposited in the river valleys during the closing part of the Ice Age, being supplied from the melting continental ice-sheet. The prevailing light cream color of the bricks made in Minnesota, like those of Milwaukee and of most brickyards in Wisconsin and North Dakota, is due to the calcareous and magnesian ingredients of the glacial clays in this region. These ingredients, derived mostly from magnesian limestone formations, unite with the iron ingredient of the clay to form a light-colored silicate, instead of the ferric oxide which in other regions destitute of magnesian limestone gives to bricks their usual red color.

At Red Wing, brickmaking was begun in 1855; at Minneapolis, about the same date; in Chaska it was begun about the year 1868; in Mankato, about 1873; and at Moorhead, in 1874. In Red Wing and its vicinity, exceptionally for this state, the bricks are red.

The manufacture of stoneware, from Cretaceous clay found in Goodhue county, was begun at Red Wing in 1877, and has become a very large and prosperous business; and within the last five years several kilns have been built there for making sewer pipe.

In the Minnesota valley, at New Ulm and Mankato, firebricks and pottery have been made during the past twenty-five years, or longer, from clay or soft shale beds of Cretaceous age, dug in the vicinity of New Ulm.

GEOLOGIC HISTORY OF MINNESOTA.

Attempting to trace very briefly the origin and sequence of the rock formations of this state, especially those which yield

ores, building stone, and pottery and brick clays, we may begin with our earliest rocks, belonging to the Archæan era, and come forward to the present time.

The granite and gneiss, and the gold-bearing quartz veins, occur in a large irregular tract of Archæan rocks, which occupies much of northern, central, and western Minnesota, and which reaches northward and northeastward far beyond our limits, to the Arctic sea and to Labrador. These rocks, in nearly their present condition, were probably a part of the earliest cooling crust of the globe or were formed somewhat later as the downward extension of that crust, which, indeed, in its outer part, must have been very long ago removed by erosion on this continental area.

In sedimentary Algonkian and Taconic rock strata, of great antiquity, though somewhat less ancient than the preceding, the Vermilion and Mesabi iron ores occur, their present concentration in workable deposits having been effected at some time long ago, but subsequent to the original formation of the inclosing strata. The processes of the ore concentration are incompletely known, and are therefore the subject of much study and discussion.

The copper-bearing rocks belong to a later division of Algonkian or Taconic time, and constitute a partly sedimentary and partly eruptive series, named the Keweenawan or the Nipigon series, for the peninsula projecting from the south into lake Superior, and for the lake and river Nipigon, tributary to this great lake from the north.

Probably during the same Keweenawan period the quartzite formation near New Ulm and at Pipestone, Luverne, and Sioux Falls, was laid down as a sandstone in the sea. Since uplifted in the continent and metamorphosed to its present condition, this formation, at the pipestone quarry, is the earliest of our rock strata in which fossils are found. They represent the earliest known fauna that tenanted the primitive ocean.

Ensuing in a continuous succession of marine sediments, deposited probably around the nucleal Archæan area of our continent as it was already roughly outlined in that very old Paleozoic era, we have further, ascending stratigraphically in

their chronologic sequence, the Fond du Lac sandstone, the Hinckley and Kettle River sandstone, the Dresbach sandstone, the St. Lawrence limestone and shales, the Jordan sandstone, the Lower Magnesian (Shakopee) limestone, the St. Peter sandstone, the Trenton limestone, and the Galena limestone, all of which have yielded building stone quarried in Minnesota. These belong to the great Cambrian and Lower Silurian periods.

Upper Silurian strata are absent from our state, which during that long period may have been wholly a land area; and the ensuing Devonian formations reach only into the southern edge of Minnesota, in the neighborhood of Austin and Albert Lea.

Next through the prolonged Carboniferous or Coal period, and the Permian period, terminating the Paleozoic era, Minnesota, so far as the record remains, received no rock deposits, being then too, as we may quite safely suppose, a somewhat elevated land area. It had no low morasses and fern jungles, receiving the treasures of generations of vegetation falling to be entombed, by later sediments spread over them, until mined as coal in our culminating epoch of man's creation, civilization, and possession of the earth.

Coming forward from Paleozoic through Mesozoic and Tertiary time, we have no rock formations to record the long history of this area, except during the late part of the vast Cretaceous period, ending the Mesozoic era. Then all of Minnesota, excepting possibly some high tracts north of the present site of lake Superior, sank beneath the Cretaceous ocean, which reached thence far westward; and great series of shales, since mainly denuded from Minnesota during the Tertiary era, were deposited on the sea bed. In these formations are the clays used for making stoneware and fire-bricks; and at times of uplift trees grew, as known by their fossil leaves, and very thin layers of lignite were formed.

After the ages of Tertiary time had rolled away, a marvelous geologic winter came upon the northern half of North America and in the British Isles and northern Europe. Snow, instead of rain, fell during all seasons of the year, and for thousands of years immense sheets of snow, compacted not far be-

neath their surface into ice, mantled these large parts of two continents with a white pall of desolation. When this Glacial period ended, with the ice melting, its drift was left enveloping the older rocks; and in the valleys stratified clays, washed from the dissolving icefields, were laid down by the swollen streams, to be in our time, by human skill, transformed into stately brick buildings and cheerful chimney corners and firesides.

To give some idea of the almost inconceivable duration of this geologic history, we may think of an audience room with a circumference of two hundred or three hundred feet. Let that distance represent all the time since life began on the earth, estimated by Dana, Walcott, and others, as probably about a hundred million years. Long before the beginning of that time, our granite and gneiss were made by the earth's cooling; and near the distant dawn of life the strata containing our iron ores were deposited. In the early part of the life time of the earth's changing and developing faunas and floras, our quarried sandstones and limestones were made on the bottom of the sea, the former near the continental shores, and the latter at greater depths. The Trenton limestone, so filled with fossil forms of the ancient life, belongs about halfway from the beginning to the present time. The Cretaceous period was comparatively near to our own; the Ice Age was geologically like yesterday, to be represented, on our scale of the circuit of the room, by only three or four inches; and the subsequent period of humanly recorded history, from the earliest known of Egypt, is no more than a tenth as long.

STATISTICS.

In concluding this paper, space remains to present only a very condensed statement of the extent and value of our production of ores, building stone, bricks, etc.*

*Detailed descriptions of our mines, quarries, and other industries which make direct use of the geological resources of the state, are given, with statistical information relative to the amount and value of their products, in the reports, partly before cited, of the Minnesota Geological Survey, in which the writer was several years an assistant; in the report by the late Prof. R. D. Irving, "The Copper-Bearing Rocks of Lake Superior" (pages 464, with 29 plates, and 37 figures, in the text, 1883), forming Monograph V of the U. S. Geol. Survey; in the present author's report, "The Glacial Lake Agassiz" (pages 658, with 38 plates, and 35 figures in the text, 1895), forming Monograph XXV of this Survey; in the U. S. Census reports; and in articles presented in the American Geologist, a monthly magazine founded in 1888, published in Minneapolis.

Minnesota began to be a contributor to the iron product of the United States in 1884. During the eleven years of 1884-94 the Vermilion range shipped 7,065,832 tons of ore; and in 1895 and 1896, respectively, 1,077,828 and 1,088,090 tons. (The figures for both this and the Mesabi range during the last two years are from H. V. Winchell, in *The Iron Trade Review*, Jan. 7, 1897.) The Mesabi range, beginning its ore shipments five years ago, produced 4,245 tons of ore in 1892; 613,620 tons in 1893; 1,788,447 tons in 1894; 2,781,587 tons in 1895; and 2,882,079 tons in 1896. The ore of this range is mostly soft hematite, worked in open excavations by the steam-shovel, which loads the ore directly on cars; but the ore of the Vermilion range is hard hematite, mined by shafts down to 500 feet below the surface. The total yield of both ranges to the present date has been 17,301,728 tons of ore. Its estimated value at the mines has varied from $2.87 per ton in 1889 to $1.55 in 1893, and, with the ensuing decrease of prices and depression of trade, $0.73 in 1894. For the thirteen years since our iron-mining began, we may estimate the average value as about $1 per ton, giving a total value of about seventeen million dollars.

According to the census of 1890, Minnesota employed 544 men during 1889 in granite quarrying and cutting, their aggregate earnings being about $288,000; in sandstone working, 199 men, earning $142,000; and in limestone working, 1,216 men, earning $374,000. The annual wages in stone working were thus about $804,000, which also measures nearly the value of the quarried and dressed stone.

In 1880 the census returns for Minnesota gave a value of $544,675 in manufactured clay products; and in 1890 this was increased to $1,331,339.

The total mineral products of Minnesota in 1889, as shown by the census taken the next year, had a value of $11,542,138, or very closely one-fiftieth of the value for the entire United States.